Items #27: Fish Habitat Change

Evaluation Objectives: To evaluate the change in habitat for bull trout and westslope cutthroat trout. Sediment affects a variety of habitat conditions, and therefore it is primary focus of this evaluation.

Methods: Fine sediment levels are monitored on the forest through two different programs. The first program is McNeil core sampling in key bull trout spawning areas by MFWP. This program began in the early 1980s and now includes 26 sites on the Flathead National Forest.

The second program is the PACFISH/INFISH Biological Opinion (PIBO) monitoring program, which is conducted across the Columbia River Basin by the Forest Service (http://www.fs.fed.us/biology/fishecology/emp/). This program began in 2001 and includes 70 sites in reference and managed watersheds across the forest. Several habitat parameters are measured in the PIBO program that directly relate to in-stream sediment, including particle size distribution, percent fines in pool tails, residual pool depth, percent pools, and bank stability. This program allows the evaluation of trends and comparison of reference and managed conditions.

Evaluation: Results of the McNeil core samples are shown in Figures 1-3 through 2006. The percent fines (<6.35 mm) appear to fluctuate between 20 and 40. The distribution of sediment material in streams is generally related to the local gradient, and also strongly influenced by seasonal flow regimes. Fines tend to build up during periods of drought and flush out during higher stream flows. Reach-scale stream gradients can change over time as channels adjust to changes in sediment and/or woody material. Based on the data, it is difficult to determine if any long term trends have occurred. It is surprising to note that sites in the North Fork and South Fork affected by fire do not show any obvious increases in fines. The sites that have recent fire activity upstream have stayed relatively constant, probably due to a gradual spring snowmelt, light spring rains, and rapid vegetative recovery following fire.

In the North and Middle Forks of the Flathead, MT FWP concludes that streambed core sampling results show fine sediment (<6.35mm) levels in spawning areas peaked around 1990, due to both natural and land management related sources and an extended period of drought (MT FWP 2006). Flushing flows beginning in 1991 improved spawning gravel quality in most sampling areas, with the exception of Coal Creek. Lack of flushing associated with the current drought (2000 – 2005) is evident in recent coring results.

It may be possible to determine possible causes of short term fluctuations in the core samples, but that would require extensive analyses of hydrologic records, management activities, and forest fires upstream of any given site. Based on the data, it is difficult to determine if current forest plan direction may be affecting fine sediment. INFISH was adopted in 1995, which provided additional protection to riparian ecosystems and established riparian management objectives. Data in figures 2-3 do not indicate any obvious decreases in fine sediment since 1995 or increases with the exception of Coal Creek. Since amendment 19 was signed (1995), the forest has decommissioned over 500 miles of road, primarily in the North Fork, lower South Fork, and Swan sub-basins. Some of this decommissioning work was implemented upstream of

core sampling monitoring sites, but there does not appear to be any notable downward trends since 1995. However, there appears to be more fluctuation in the North and Middle Forks of the Flathead prior to 1995 (Figure 1), the cause of which is unknown.

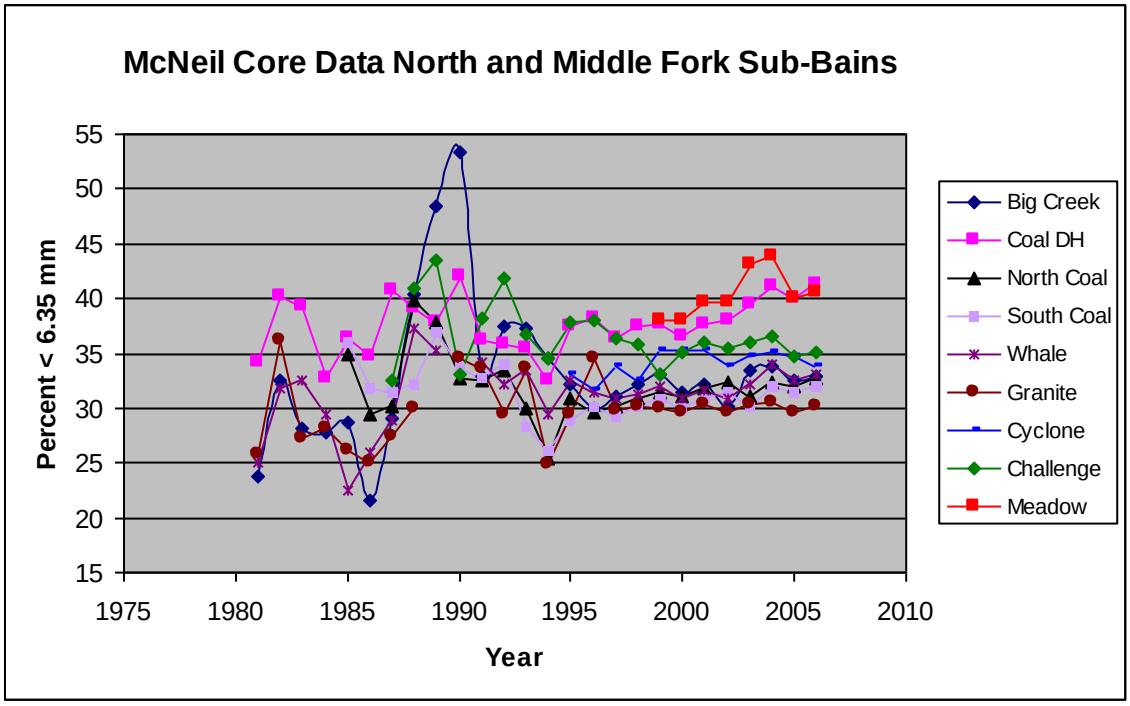

Figure 1. McNeil core sample data at bull trout spawning sites in the North and Middle Fork Flathead Sub-Basins.

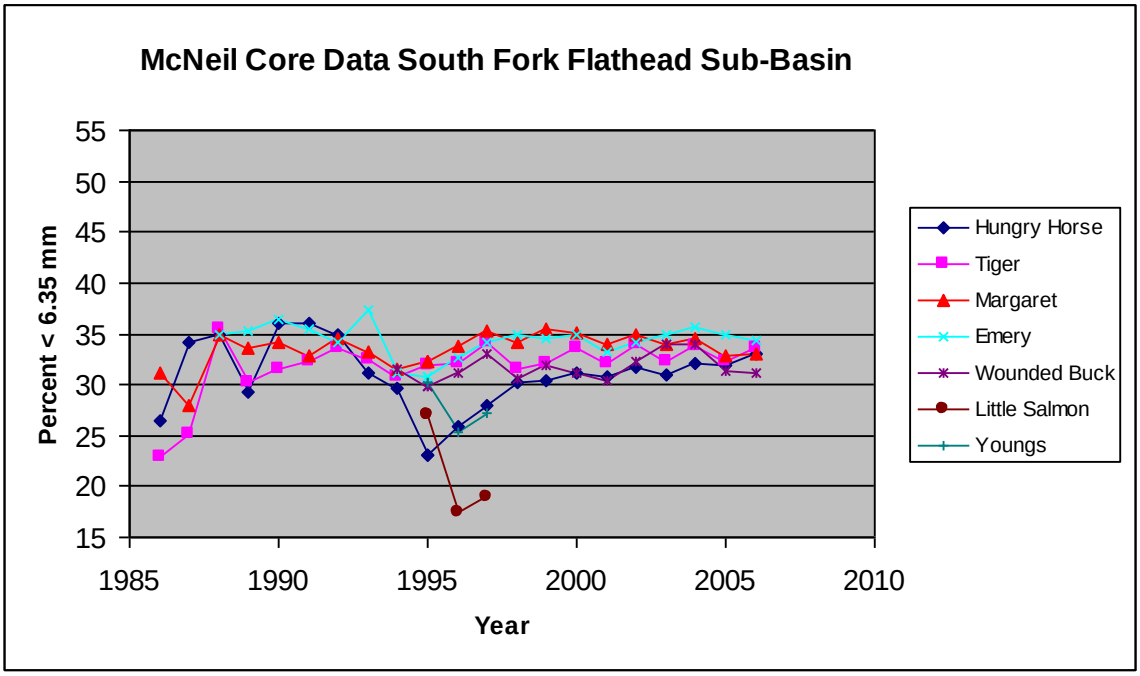

Figure 2. McNeil core sample data in the South Fork Flathead Sub-Basin.

The only bull trout streams in the Figure 2 (South Fork) are Wounded Buck, Little Salmon, and Youngs Creeks. Little Salmon and Youngs Creek are both in the Bob Marshall Wilderness.

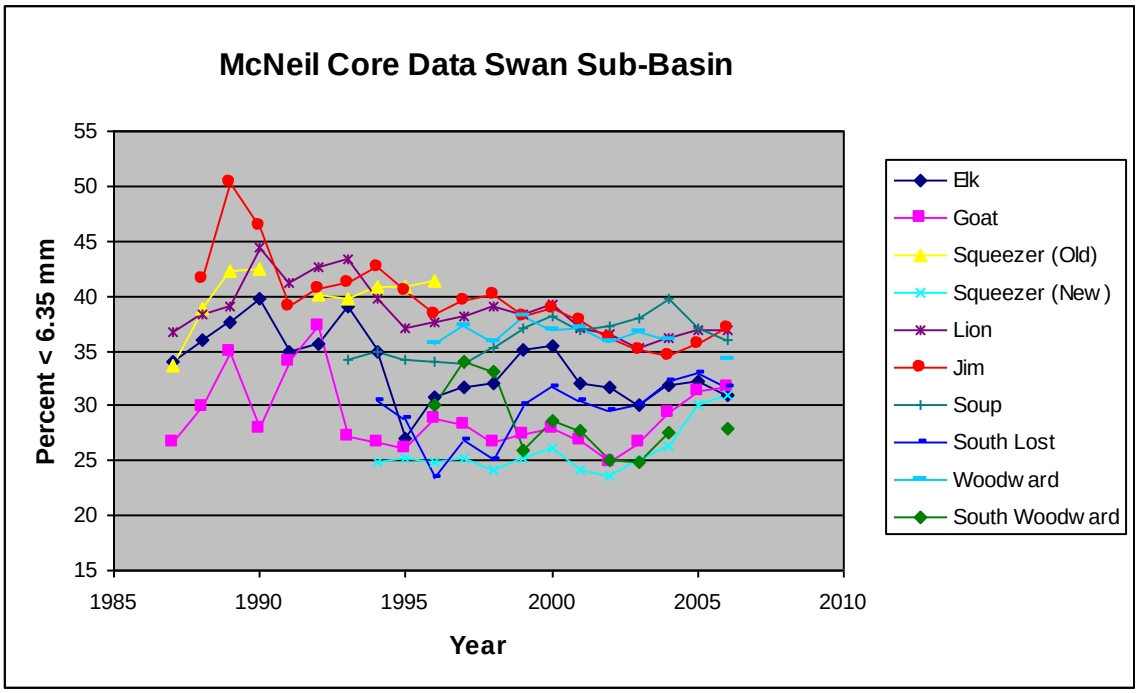

Figure 3. McNeil core sample data at bull trout spawning sites in Swan Sub-Basin.

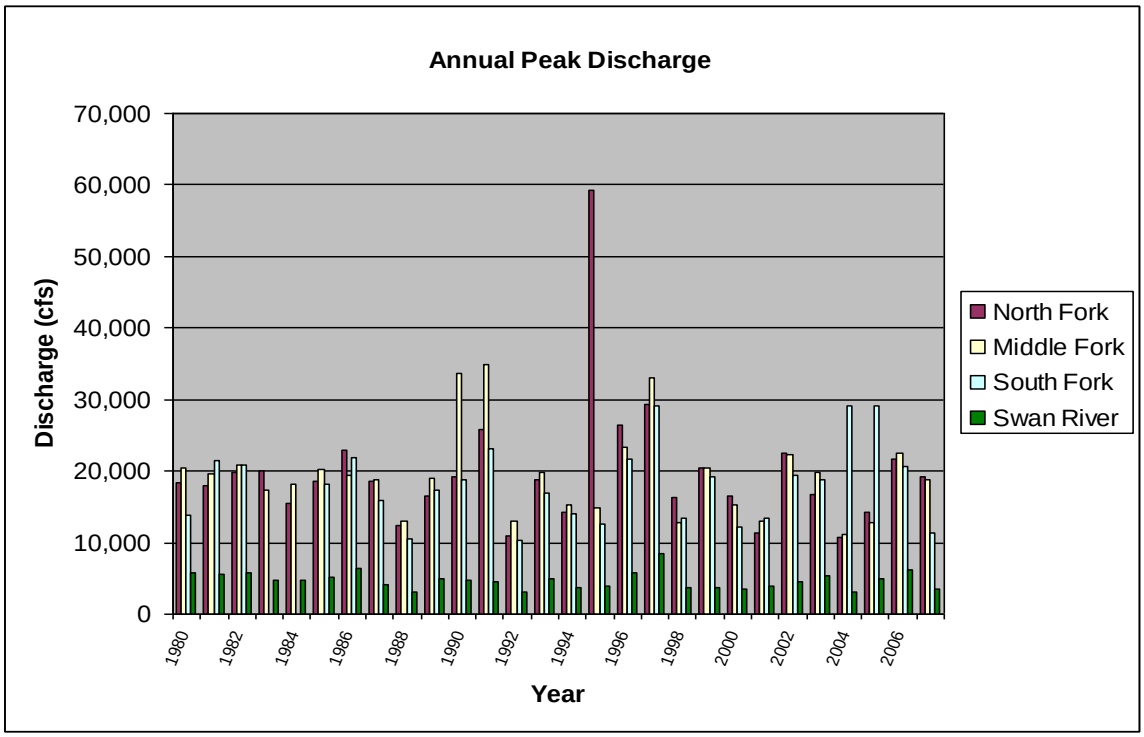

Figure 4. Annual peak discharges between 1980 and 2007 in the three forks of the Flathead River and the Swan River.

Some of the fluctuations in fine sediment around 1990 could have been the result of relatively high annual peak discharges (Figure 4). By contrast, annual peaks in 1996 and 1997 are not associated with such fluctuations in fine sediment. This illustrates the extreme complexity of sediment transport in streams.

In August 2008, the PACFISH/INFISH Biological Opinion (PIBO) Program released an executive summary and whitepaper that summarized some general conclusions about measured trends in stream habitat parameters across the Columbia River Basin (USDA 2008). For most habitat attributes, including sediment and sediment-related attributes, no differences between reference and managed sites could be distinguished in a detailed analysis of trends. This is due to a relatively small sample size over a large area and the fact that trends in aquatic habitat in both reference and managed sites appear to track each other. This is either because managed and reference sites are both trending upward due to "natural or climatic changes", or because small sample sizes are preventing the detection of trend differences that are actually occurring (USDA 2008).

Kershner et al. (2004) analyzed the differences in habitat conditions (including sediment) between reference and managed watersheds across the Interior Columbia River Basin. This study found small, but statistically significant differences in habitat parameters in reference and managed watersheds. These parameters include residual pool depth, bank stability, bank angle, undercut banks, and median particle size. The results of this analysis were generated using analysis of covariance (ANCOVA) techniques to account for differences in stream characteristics such as size and gradient. To assess differences between reference and managed stream conditions on the Flathead National Forest only, an identical analysis was conducted in 2008 using the same covariates identified by Kershner et al. (2004). These covariates include mean bankfull width, gradient, and precipitation. The statistical analysis was conducted by PIBO personnel in Logan, Utah, and the results are shown in table 27-1. In this analysis, the percentage of reach in forested condition was identified as a fourth covariate.

Table 27-1. ANCOVA-Adjusted Means and Standard Error Values for Sediment-related Habitat Variables in Managed and Reference Sites on the Flathead National Forest.

	ANCOVA RESULTS				
Variable	**Managed Mean (n=42)**	**Managed SE**	**Reference Mean (n=28)**	**Reference SE**	***P*-value**
Residual Pool Depth (m)	0.36	0.029	0.34	0.04	0.59
Percent Pools	43.7	2.8	44	3.6	0.95
Median Particle Size (m)	0.047	0.004	0.052	0.01	0.42
Percent Pool Tail Fines	13.1	1.2	14.3	1.2	0.75

The results of the analysis of covariance (ANCOVA) indicate no statistical difference between sediment-related habitat variables, as indicated by p-values greater than 0.10. This would indicate that management activities are not measurably affecting sediment-related habitat variables. However, the results shown in table 27-1 may be misleading because of the high variance and small sample size of the reference data. Another type of statistical test was completed using multiple linear regressions for each response variable with the covariates as

independent variables using the reference data only. This approach basically uses the reference data to predict what the variables in managed sites. The residual values are then tested against the reference values to determine significance. The results of this approach are shown in table 27-2.

Table 27-2: Regression analysis of sediment-related variables in managed and reference sites on the Flathead National Forest.

	REGRESSION RESULTS				
Variable	**Mean Residuals Managed (n=42)**	**Managed SE**	**Mean Residuals Reference (n=28)**	**Reference SE**	***P*-value**
Residual Pool Depth (m)	-0.117	0.04	0	0.033	0.0004
Percent Pools	-3	2.7	0	3.1	0.27
Median Particle Size (m)	-0.014	0.005	0	0.004	0.003
Percent Pool Tail Fines	1.4	2.7	1	2.4	0.03

The regression approach yielded significant differences between the reference and managed sites for residual pool depth, median particle size, and percent pool tail fines. However, the differences in percent pools and percent pool tail fines are extremely small. Figure 5 displays residual pool depth against bankfull width (one of the covariates). The regression lines in this plot indicate a very subtle difference between the reference and managed streams, when only one covariate is considered.

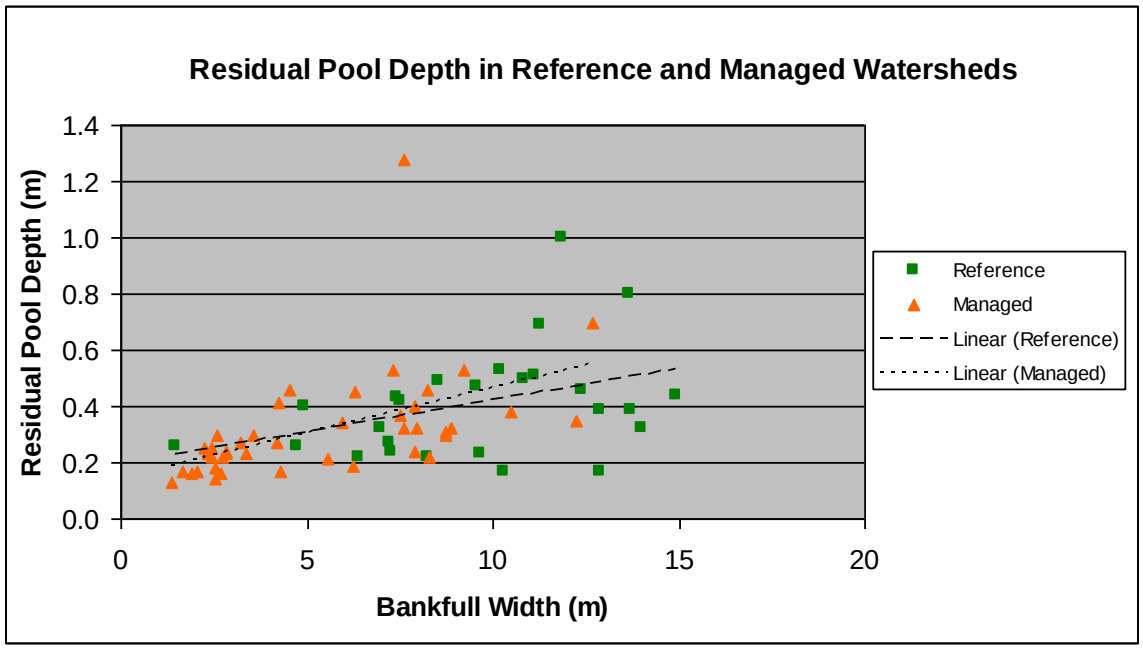

Figure 5. Residual pool depth as a function of the bankfull width covariate in managed and reference sites on the Flathead National Forest..

The relationship between the stream gradient covariate and median particle size illustrate a more substantial difference between the reference and managed conditions (Figure 6).

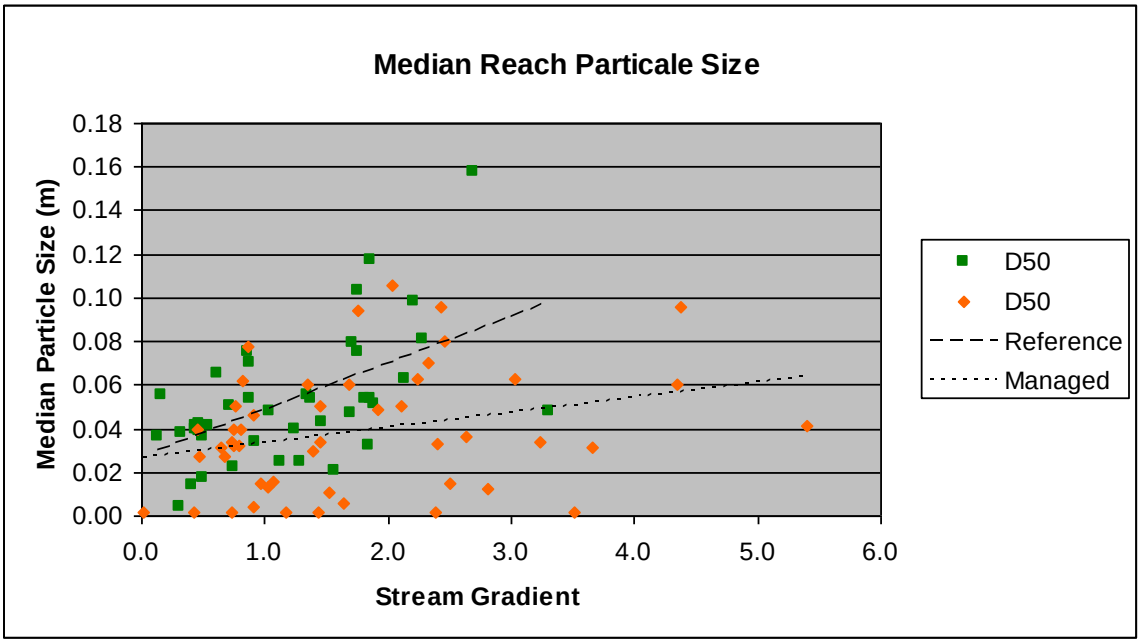

Figure 6. Median particle size as a function of the stream gradient covariate in managed and reference sites on the Flathead National Forest.

Analysis of the PIBO data demonstrates that sediment-related habitat parameters are extremely variable, and that the effects of management activities on them are not always apparent. The ANCOVA suggests that management activities are not measurably affecting sediment-related habitat parameters. By contrast, the regression approach yielded very small, but significant differences between reference and managed conditions. However, these results should be viewed with caution due to the small sample sizes and limited number of years that this data has been collected. The distribution of bed material sizes in any stream is influenced year to year by varying levels of stream flow. As stated earlier, finer material tends to accumulate during drought periods and flush during higher flows. The dataset shown in Figure 6 is the result of multiple years of data collection. Therefore, some of the variability may be the result of differences in stream flow conditions among sample sites.

Recommended Action: It is recommended that sediment or sediment related parameters continue to be reported. Additional data collection through the PIBO program will help determine how habitat conditions are changing over time, and how they might be affected by climatic conditions and trends.